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DURSBAN AND ZECTRAN PILOT CONTROL STUDY FOR DOUGLAS-FIR TUSSOCK MOTH

by

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ABSTRACT

Zectran and Dursban insecticides applied by helicopter at the rate of one-quarter pound in a gallon of cycle oil per acre failed to control the Douglas-fir tussock moth. The test was made in the infested stand of true and Douglas-firs on the Malheur National Forest in central Oregon during 1965.

THE PROBLEM

Defoliation by the Douglas-fir tussock moth (Hemerocampa pseudotsugata) has caused the loss of hundreds of millions of board feet of timber in the Western States. Larvae of this moth, native to the forests of western North America, feed on the old and new foliage of Douglas-fir and true firs and will, when deprived of these preferred hosts, feed on pine and other tree species. During one outbreak in 1929-30 in eastern Washington, 300 million board feet of timber were destroyed.

An outbreak of this moth developed on the Malheur National Forest in central Oregon during 1964. Defoliation was heavy with tree mortality occuring in some areas. Therefore, 66,000 acres were sprayed in the spring of 1965 to prevent additional defoliation and tree killing. The insecticide used was DDT at the rate of 3/4-pound per acre. Helicopters applied the insecticide to insure even coverage and to prevent contamination by insecticide drift into streams and other critical areas.

While DDT does an excellent job of controlling the moth, the possibility of adverse effects from DDT on wildlife has shown the desirability of finding another insecticide that can be used in its place. Such material should be as effective an insecticide as DDT but with a short residual life.

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OBJECTIVE

Insecticide screening tests at the Pacific Southwest Forest and Range Experiment Station found two chemicals less persistent than DDT that showed promise of controlling the tussock moth. These two insecticides were Dursban, the Dow Chemical Company trade name for 0,0-Diethyl 0-3,5,6-Trichloro-2-Pyridyl Phosphorothioate and Zectran which is 4-Dimethylamino-3,5-Xybyl Methylcarbamate.

During recent years DDT has given excellent results in controlling the tussock moth when applied at one pound per acre. During the current outbreak DDT at three-fourths pound per acre gave control at the 98 percent level. Dursban and Zectran field tests were planned to determine if these chemicals would show control equal to DDT and if any operational difficulties might be encountered. The application of the chemicals was undertaken as a pilot control study and not as a designed experiment. There was not enough material available for replicate treatments, and lacking these, no statistical tests for significance could be made. It was thought that a pilot test without replications was worth doing as observations and measurements made of insect mortality within the sprayed area compared with adjacent unsprayed areas would give an indication of the value of these insecticides in controlling the tussock moth. An opportunity would also be available to work out operational difficulties that might arise in the handling and application of these materials.

PROCEDURE

A test area was selected in a 360-acre tract of timber infested with tussock moth and located near Haystack Meadow, Malheur National Forest. This area was 1-1/2 miles from the nearest area sprayed with DDT on the major control project so there was no problem of contamination from insecticide drifting into the test area. Timber type was a mixed stand of fir and ponderosa pine bordered on two sides with meadows.

Spray plots consisted of two rectangular areas 400 feet by 2,200 feet laid out in the test area. These spray areas were separated by a 2,400-foot wide strip of unsprayed timber. The four corners of each area were marked with 3-by 3-foot flags of red fluorescent cloth on poles extended through the crowns of trees. In addition the tips of several dominant trees on the long side of each area were sprayed with red fluorescent paint from a helicopter using a 7-foot wand.

Eighteen larval mortality study plots were established--six in each of the two areas that were sprayed and six check plots in the unsprayed area adjacent to but at least 750 feet from the sprayed areas. Each plot consisted of three white fir trees with light to moderate tussock moth defoliation in 1965. Each tree on the plots

had 1964 egg masses present as well as adequate foliage to attract the moths. Heavy defoliation and tree mortality had occurred within 200 feet of all plots. Tree size ranged from 25 to 45 feet with branches which could easily be examined from the ground.

Each tree selected was tagged with a large yellow card containing the plot number. In addition, white marking tape was hung on the trees surrounding the plots.

Insecticide mixing was done at the heliport located in the meadow adjacent to the test area. The spray system of the helicopter, which had previously been calibrated to spray at the rate of one gallon per acre, was cleaned and checked for leaks.

Dursban insecticide concentrate, which was received in a liquid form, was added to Shell light cycle oil in a steel drum. The concentrate was added at the rate of 1/4-pound of technical Dursban per gallon of spray mixture. This solution was then stirred for ten minutes with a motor-driven mixer. Enough extra spray was prepared to prime the helicopter spray system and to allow for dead spots in the spray tanks.

After the Dursban test area was sprayed the spray system was drained and the tanks cleaned. The entire spray system was then flushed with clean cycle oil.

Zectran in crystal form was dissolved in methylene chloride. This solution was then added to a clean steel drum containing cycle oil. The solution was added at the rate of 1/4-pound of technical Zectran per gallon of spray and agitated for 10 minutes with the mechanical mixer before being pumped into the helicopter.

After the Zectran test area was sprayed the spray system was again cleaned before the helicopter was released.

Application of the insecticides was made on July 8, 1965, between the hours of 5:30 and 6:15 a.m. The temperature during this period was in the middle 50's. Wind velocity during the application of Dursban was 1 mile per hour and varied from 1 to 6 miles per hour during application of Zectran.

Application was at the rate of 1 gallon per acre of spray containing 1/4-pound of active insecticide per gallon. The spray system was primed while flying over the open meadow before spraying of the test areas started. Test areas were clearly marked, and in addition, a flagman was used to direct the pilot to the center of each spray strip. Five spray runs were made through each test area with all swaths made lengthwise through the areas and in the same direction.

The foliage was dry when insecticide application was made on July 8 and no precipitation occurred until July 17.

Spray coverage was determined from five 4x5 inch oil-sensitive spray deposit cards placed at intervals under and around the trees at each study and check plot. These cards were stapled to 10- x 12-inch sheets of cardboard which prevent the deposit cards from curling or blowing. Cards were distributed the afternoon of the day before application and were picked up 1 to 2 hours after spraying was completed.

Larval population counts before and after spraying to evaluate the success of the insecticides were difficult to plan and execute. After hatching, the first instar larvae cluster on the cocoon and then migrate to the ends of the twigs where they can readily be found but are difficult to count. During the second instar they disperse throughout the foliage and to adjacent trees. During this period the small larvae are hard to see and an accurate count is difficult. Any count made during the first two instars would be hard to correlate with counts made in the same sampling area at a later date. For this reason insecticide application was aimed at the third instar when larval spread had slowed and they were large enough to be seen and counted without the aid of a magnifying lens.

To determine larval mortality caused by the insecticide three methods were used. In the first, drop trays were placed under the trees on the sprayed and check plots to catch dead and dying larvae as they fell from the foliage. Three trays, each 2 square feet in area, were placed in each of the 12 spray plots and the 6 check plots. Dead larvae that had fallen into these trays were counted 24 and 72 hours after application.

A second method used to measure larval mortality was the counting of all the larvae one observer could see on a plot during a 15-minute observation period. These counts were made one day prior to spraying then one, three, and ten days after spraying. All counts on each plot were made by the same observer with the exception of the final ten-day count.

The third and final method used was a survey to determine the ratio of new egg masses to old egg masses present on the study plots at the end of the summer. Transects were run across each of the sprayed and checked areas and all old and new egg masses were collected from one branch of each tree along the transect. At least 500 egg masses (total old and new) were collected from each area. These egg masses were then examined under magnification at the laboratory and classed as new unhatched eggs laid during 1965 or as old hatched eggs laid previously to 1965.

RESULTS

Of the six study plots in the area sprayed with Dursban, one did not receive adequate spray coverage and one did not have sufficient moth population. One other plot had poor spray coverage and a low population so these three plots were dropped from the Dursban test.

In the area sprayed with Zectran, three plots were also dropped from the test due to poor spray coverage and low moth populations. Two of the six check plots were dropped due to low population and one other when it became contaminated by insecticide drift.

This left a total of nine acceptable plots--three in each of the test areas and three check areas. These had adequate moth populations and those in the insecticide test areas had good coverage on all spray deposit cards.

Drop trays examined at intervals of 24 and 72 hours after spraying showed that a considerable number of moth larvae had been killed (table 1). The 50.1 dead larvae per square foot of drop tray surface collected during the first three days after spraying in the Zectran study area were significantly greater than the 34.7 in the Dursban study area where the original moth population had been higher.

Table 1.--Dead Douglas-fir tussock moth larvae in drop trays 24 and 72 hours after application of insecticides

Area	Number of dead larvae per square foot of drop tray	
	24 hours	72 hours
Dursban sprayed	29.1	5.6
Zectran sprayed	37.1	13.0
Check areas	0.7	0.8

Larval population counts made one day prior to spraying and at intervals of one, three and ten days after spraying showed that a considerable number of larvae appeared to be unaffected by the insecticide and continued to feed on the foliage ten days after spraying (table 2). These counts also demonstrated how much easier it is

to see and count the larvae during the later instars. Larval numbers increased on all check plots and on one each of the Zectran and Dursban plots when the three-day post-spray counts were made. Under these conditions it was not possible to determine the percentage of the moth populations that had been killed but there was a considerable number remaining alive on the trees.

Table 2.--Douglas-fir tussock moth counts made in test areas 1 day before spraying and 1, 3, and 10 days after spraying

Plot	Number of live larvae observed in 15 minutes			
	Pre-spray	Post-spray		
	1-day	1-day	3-day	10-day
Dursban 1	137	39	56	8
2	107	21	75	58
3	71	43	85	31
Total	315	103	216	97
Zectran 1	107	42	32	1
2	75	40	52	33
3	61	74	116	21
Total	243	156	200	55
Check 1	228	302	390	106
2	42	73	56	11
3	102	114	110	7
Total	372	489	556	124

Sometime between the third and tenth day after spraying, larval mortality from a polyhedral virus disease began to occur throughout the study area. This was confirmed by Dr. G. G. Thompson at the Corvallis Forestry Sciences Laboratory of the Pacific Northwest Forest and Range Experiment Station, who examined larvae collected in the area during this interval. Therefore, all the moth population reduction occurring during this period cannot be attributed to the insecticides.

New to old egg ratio surveys made during October were of no value in measuring the effectiveness of the insecticide as the virus disease had wiped out the entire larval population in the study area prior to pupation. On the transect lines 2,062 old egg masses were collected without a single new egg mass being found.

DISCUSSION

A month after application of the insecticides, the study area was scouted. Large number of live larvae were still feeding and defoliation had occurred in all three areas. This was quite a contrast to the situation on the major spray project where DDT had been used. There it was extremely hard to find a single live larva.

Although the test insecticides were applied properly and under ideal conditions, the number of larvae still present on the trees in the study plots indicated that Zectran and Dursban at the 1/4-pound per acre rate were not acceptable as a method for controlling the Douglas-fir tussock moth. Indications were that Zectran at a higher rate of application than 1/4-pound per acre might give acceptable control.